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Complete Specification for the invention entitled :

"DIAPER FOLDING APPARATUS"

The following statement is a full description of this invention, including the best method of performing it known to me/us :

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## ABSTRACT OF THE DISCLOSURE

A diaper folding apparatus employing an open frame drum equipped with a rapidly projecting tucker to force an intermediate diaper portion into a takeaway system and over aligned plates to develop leg folds.

Conventionally, disposable diapers are made on high speed machinery and consist of an outer web of moisture proof material such as polyethylene, an internal layer of wadding or fluff of great absorbency, and an inner (relative to the infant) layer of moisture permeable material such as a non-woven cellulosic material. These webs are united at high speed (several hundred diapers per minute) in a continuous fashion in an elongated machine, the output being the final folded diaper ready for packaging.

Most of the operations in the diaper making machinery are performed with the webs travelling in a straight line at relatively high speed. However, the folding has been different, particularly when leg folds are introduced, i.e., approximating the diaper to the historical "three cornered" variety. Even though rotary mechanisms for introducing such folds have been developed and utilized, it would be desirable to have a high speed simple, yet rugged folding device which operates in conjunction with the high speed diaper forming machine -- and the provision of such is an important objective of this invention.

According to the invention, an open frame drum is employed which is rotated in the path of diapers issuing from the forming machine, the frame being equipped with a rapidly projecting or emerging tucker which thrusts an intermediate portion of the diaper into a takeaway belt system while the

diaper is pulled over forming plates which develop the leg fold.

The invention is described in conjunction with the accompanying drawings, in which;

Figure 1 is a schematic elevational view of a portion of disposable diaper producing apparatus;

Figure 2 is an end elevational view as would be seen along the line 2-2 of Figure 1;

10 Figure 3 is a fragmentary perspective (and partially schematic) view of the drum portion of the apparatus as seen in the upper right hand portion of Figure 1;

Figure 4 is a fragmentary perspective view looking into the drum of Figure 3 but additionally showing a diaper in the process of being folded;

Figure 5 is a fragmentary side elevational view of the folding apparatus of the invention and which shows in detail the path of movement of the tucker blade in achieving a fold; and

20 Figure 6 is another fragmentary side elevational view of the folding drum and featuring the arrangement of vacuum heads for supporting edge portions of a diaper for folding.

In the illustration given, and with reference first to Figure 1, the numeral 10 designates generally a folding drum which is seen in the process of folding a diaper 11 (see also the extreme upper portion of Figure 2). Prior to the folding initiated by the drum 10, a web 12 of disposable diaper material, i.e., conventionally the polyethylen outer web, fluff or wadding core, and non-woven inner layer, is advanced through scoring rolls 13 and an adhesive applicator

roll 14 by means of belt systems 15 and 16. The web 12 is cut into discrete segments by a cutoff roll generally designated 17 and which coacts with the drum 10.

Referring, for the moment, to Figure 6, the drum 10 is again seen and is equipped with a plurality of vacuum heads 18. Each vacuum head 18 has, intermediate its length, an anvil 19 which coacts with a cutoff blade 20 mounted on the cutoff roll.

10 Still referring to Figure 6, the drum 10 is a "4-time" roll in that each revolution of the drum will produce four diapers. The diaper previously referred to by the numeral 11 is represented schematically in Figure 6 by the dashed line designated 11'. It will be seen that the diaper 11' extends between adjacent anvils 19 so that the leading edge portion of the diaper 11' (or 11, as the case may be) is supported on one vacuum head while the trailing portion of the diaper is supported on the next following vacuum head 18 -- the direction of the drum 10 in Figure 6 being designated by the numeral 21.

20 It will be appreciated that the diaper web 12 is cross-sealed at regular intervals, i.e., each 16". Thus, the cutoff 20 engages an anvil every 16" to provide a stream of unfolded disposable diapers.

The commencement of the folding operation is best seen in Figure 4 where a tucker 22 (see also the extreme lower portion of Figure 6) engages an unsupported, intermediate portion of the diaper. Therefore, it is advantageous to provide a drum 10 of the open frame type wherein the tucker can be mounted internally and have adequate room to emerge rapidly and develop the partial transverse fold. By partial

transverse fold, we refer to the fact that the tucker 22 is relatively narrow, i.e., of the order of 1" in width -- as compared to the normal diaper width of 8". The action of the tucker 22 on the diaper 11 develops a useful pocket or crotch in the diaper and sets the stage for the development of the leg folds 23 (designated only in Figure 4).

10 The tucker 22 serves to introduce or thrust a central partially folded portion of the diaper 11 between the center pair of belts 24 of the belt takeaway system generally designated 25. A diaper 11 in this orientation can be seen in the lower central portion of Figure 5. We find it useful to employ cog or ribbed belts for this purpose, and entraining the same over cog wheels as at 26 (see Figure 5).

20 At the same time that the central, partial fold in the diaper is being urged by the tucker 22 into the nip 27 between the belts 24, the portions of the diaper 11 lateral of this central transverse fold are forced over forming plates 28 (see particularly Figure 2). The forming plates are essentially planar and are disposed on the machine frame 29 (see Figure 3) in aligned, spaced apart relation so as to accommodate the entry therebetween of the tucker 22.

30 An "air assist" is used to develop the leg folds 23. For this purpose, the planar plates 28 are hollow and equipped with air jet apertures as at 30 (see Figure 4) which provide timed air jets. Thus, at the time the diaper is passing downwardly (compare Figures 2 and 4), the air jets are actuated so as to force lateral portions (relative to the portion contacted by the tucker 22) upwardly to form a pair of infolds 31 and 32 (see Figure 4) on each side of and aligned with the partial outfold 33 (see Figure 2) which represents

the pocket of the diaper. At the same time angularly developed outfolds as at 34 (see Figure 4) are developed in the diaper.

Referring now to Figure 3, it will be seen that the drum 10 is also mounted on a portion of the machine frame 29 via suitable bearings as at 35. The axle 36 of the drum 10 is suitably driven by a motor (not shown) in synchronism with the belt systems 15 and 16 (see Figure 1) so as to develop the same surface speed as the linear rate of travel as the web 12. To power the tuckers 22 (and with a 4-time drum 10, as seen in Figure 6 four tuckers are required), a belt and pulley system generally designated 37 (see Figure 3) is provided. For simplicity of illustration and ease of understanding, we have shown the drive for only one tucker. The tucker arrangement we prefer is of the epicyclic type to provide a pattern of tucker-tip movement such as that designated by the numeral 38 in Figure 5. To achieve this, we provide each tucker assembly with a cross shaft 39 (see Figures 3-6) which is driven by the belt system 37. The tucker blade 22 as can be best seen in Figures 3 and 4, is mounted on a cross bar 40 which in turn is mounted eccentrically relative to the stub shafts 39 by means of crank arms 41 (best seen in Figure 4). In the illustration given, each tucker rotates at twice the speed of the drum 10 and in the opposite direction, i.e., clockwise as at 42 (see the bottom portion of Figure 6) as contrasted to the clockwise rotation of the drum as seen by the arrow 21. For example, and with reference to Figure 6, the uppermost tucker 22, i.e., the one in the 12 o'clock position, is seen to be disposed radially inwardly, i.e., straight down. By the time the drum has made

on quarter rotation -- so as to bring th tucker 22 to the 9 o'clock position, th tucker blad 22 has swept through  $180^{\circ}$  and is now pointing straight up. Ther fore, during this rotation, the tucker blad 22 has, when it is position d half-way between the 12 o'clock and 9 o'clock position, assumed an orientation where it is directed radially outwardly and this is the extreme upper end of the pattern designated 38 in Figure 5, i.e., as at 38'.

10           Thereafter, as the drum 10 continues to rotate in a counterclockwise fashion, the stub shafts 39 follow the circular path 43 indicated in Figure 5. However, the cross shaft 40 follows an epicyclic path as shown by the sequenc of circles in the left hand portion of the drum 10 in Figure 5. This causes the tucker blade to sweep through th path 38 from one point of issuance 38' to the bottom position in Figure 5 wherein the tucker is engaged in the folding operation. The various dispositions of the tucker blad 22 are shown in dashed line from the various circles 40' to th envelope line 38. This particular type of motion is quite 20           satisfactory for tucking in that there is a relatively quick protrusion of the tucker, i.e., a small rotational movement of the drum results in a substantial change of attitude of the tucker blade, i.e., characteristic of the "cusp" associated with epicyclic movement.

Means in the form of the sector roll 44 (see Figure 5) are provided for controlling one of the edge portions of the diaper 11 against displacement upon engagement of the diaper by the tucker 22. This insures that each diaper will be transversely folded at the same position. It 30           will be appreciated that the diaper is initially held in

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conformity with the exterior of the drum, i. ., against the vacuum heads 18 and that as the tucker 22 emerges, th diaper must slide relative to one or both of th vacuum heads in order to accommodate the tucking action. By controlling the leading edg of the diaper, only the trailing edge of the diaper slides relative to its associated vacuum head 18 until released by sector roll 44. This, then insures that each successive diaper will be folded at precisely the same position longitudinally of the diaper. As with the drum 10, the sector roll 44 is rotatably supported on the frame 29 and is driven in synchronism with the drum 10 through suitable gearing (not shown). The same is true of the belt system 25, i.e., being driven in synchronism with the remainder of th folding apparatus. From a consideration of Figures 1 and 2, it will be seen that side belts 45 and 46 are provided in addition to the belts 24, these being foreshortened at the upper end of the run to accommodate the forming plates 28.

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Omitted, for the sake of clarity, is the vacuum manifold or valve which is essentially a crescent-shaped device mounted on the frame 29 and disposed about the lower portion of the drum 10, i.e., so as to come into communication with the vacuum passage 47 (see the lower left hand portion of Figure 6) at about the time when the associated vacuum head 18 is in the 9 o'clock position. This permits the drum 10 to pick up the web W when it comes into tangency as seen in the upper left hand portion of Figure 5.

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We also find it advantageous to provide shields or guides 49 and 50 (see the lower portion of Figure 5), aligned with the path of movement of the tucker 22. Particularly, the guide 50 fits into the space between the align d forming



plates 28 and prevents premature gripping of the partially folded diaper by the belts 24. The shields 49 and 50 are also supported on th frame 29.

The claims defining the invention are as follows:

1. Apparatus for folding disposable diapers comprising a frame, means operably associated with said frame for advancing unfolded disposable diapers, a drum mounted on said frame in the path of diaper advancement, said frame being equipped with suction means for holding the leading and trailing edge portions of the diaper against the drum, said drum being relieved in the portion confronting the portion of said diaper between said leading and trailing edge portions, a tucker mounted in said drum for rapid projection from said drum against said diaper confronting portion to develop a partial transverse outfold in said diaper, said frame being equipped with a pair of aligned, spaced apart generally planar folding plates extending generally radially of said drum and positioned adjacent a point in said path where said tucker projects from said drum whereby said tucker is adapted to project between said plates in developing said transverse fold, each folding plate being equipped with a radially inwardly directed air jet cooperable with said plates in developing transverse infolds aligned with and on each side of said partial outfold, and a belt system for gripping a diaper to move the same generally radially away from said drum while said diaper infolds are passing over said plates.

2. The structure of claim 1 in which said frame is equipped with further means for controlling one of said edge portions against displacement upon engagement of a diaper by said tucker.

3. The structure of claim 1 in which said folding plates are each equipped with timed air jets directed radially inwardly of said drum for assisting in developing of said

transverse infolds.

4. The structure of claim 1 in which a plurality of tuckers are mounted in said drum, each of said tuckers being mounted for epicyclic movement.

5. The structure of claim 1 in which said frame is equipped with guides to prevent premature engagement of said belt system with a diaper in the process of being folded, said guide being mounted in alignment with the space between said folding plates and with one of said guides projecting toward said belt system.

6. The structure of claim 1 in which said belt system includes at least three pairs of belts arranged in side-by-side relation, the centre pair extending closer to said drum to engage said partial outfold while the remaining belt pairs engage the portion of said diaper constituting said infolds.

DATED this TWENTIETH day of FEBRUARY, 1975

PAPER CONVERTING MACHINE COMPANY

Patent Attorneys for the Applicant  
SPRUSON & FERGUSON

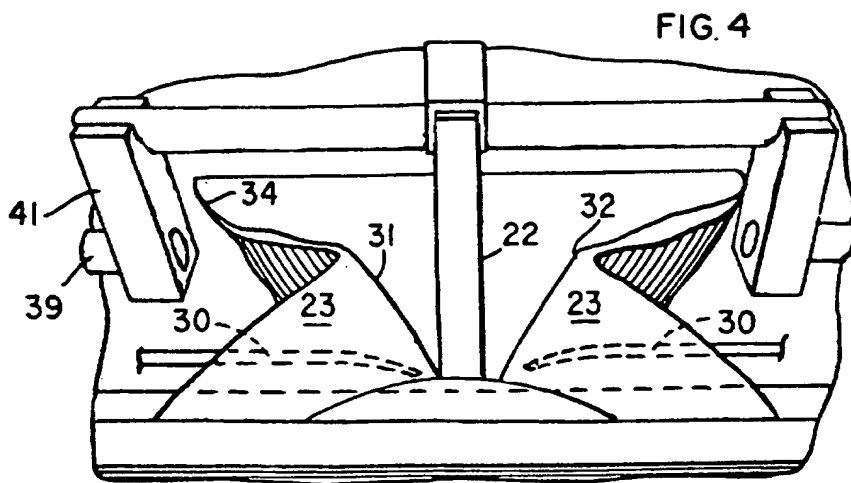
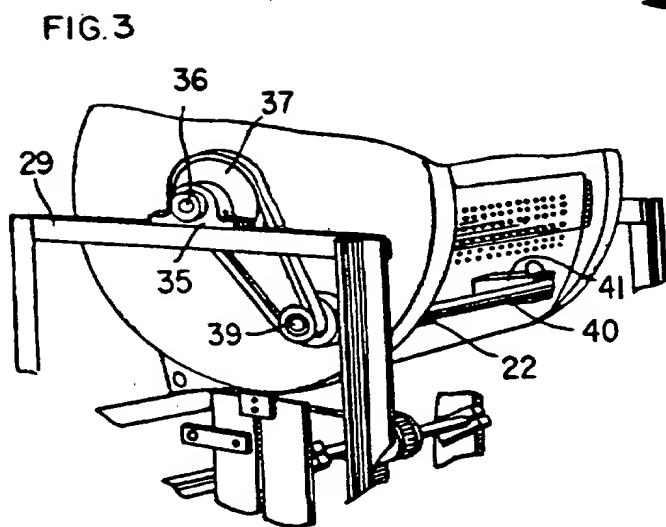
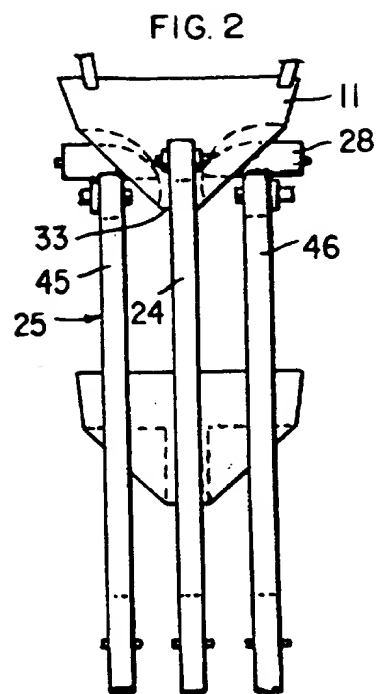
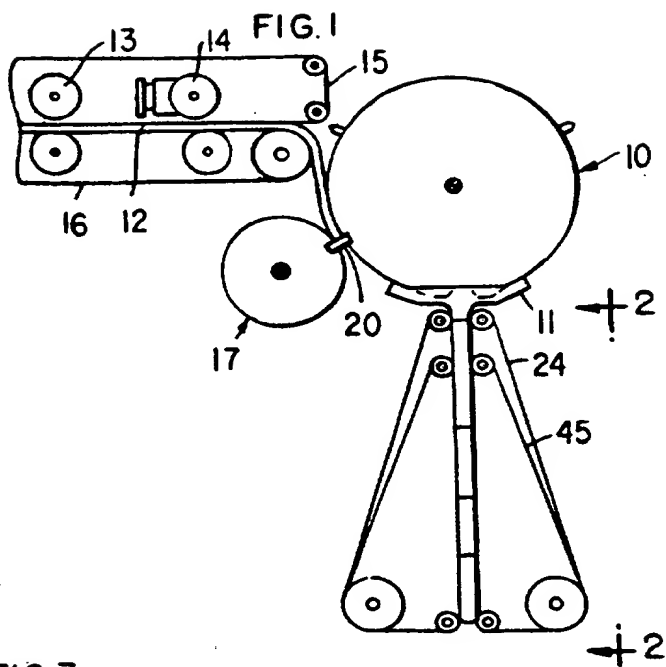


FIG. 5

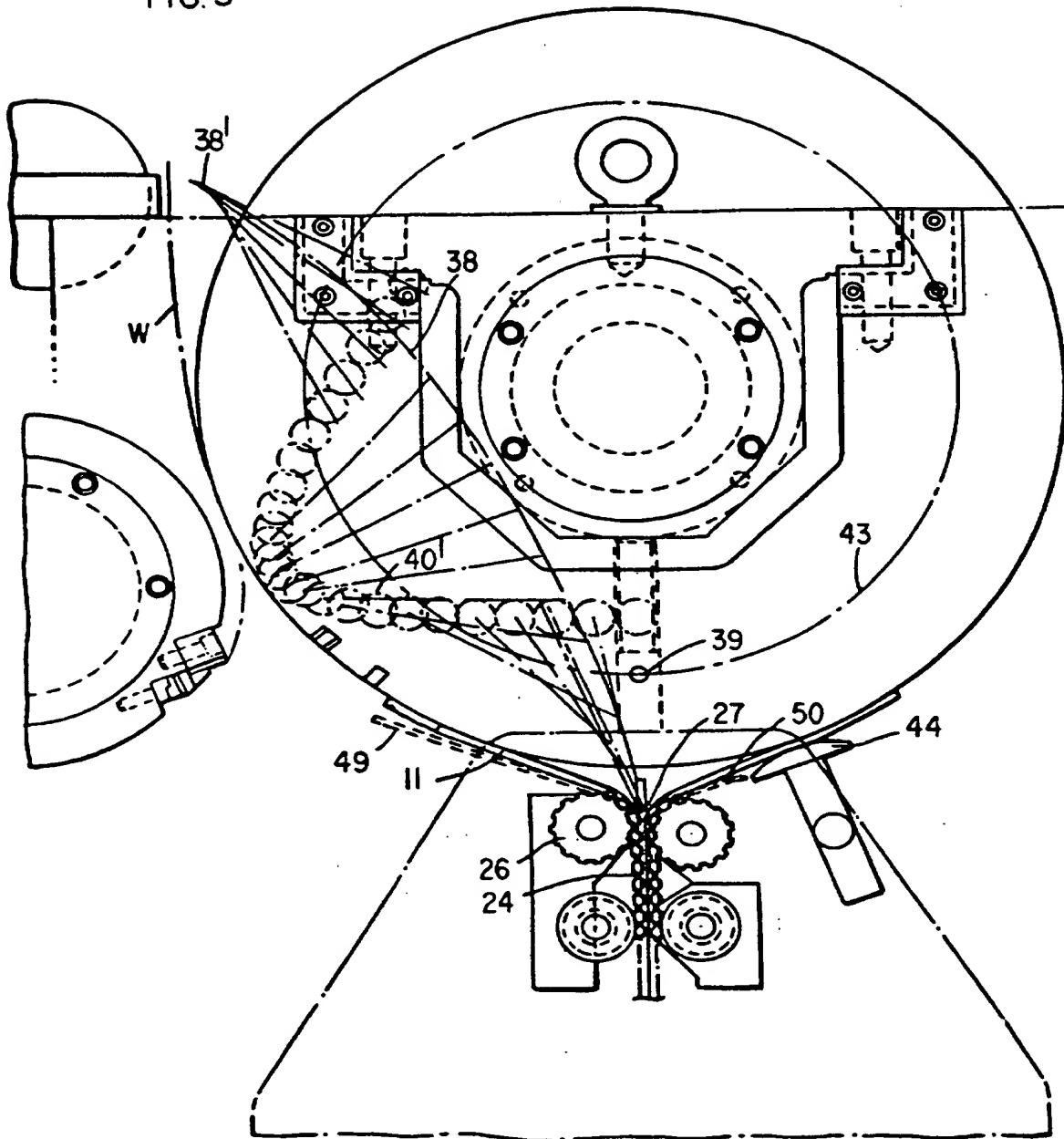


FIG. 6

